FLORENCE COPPER

**FLORENCE COPPER INC.**
1575 W. Hunt Highway, Florence, Arizona 85132 USA
florencecopper.com

February 14, 2020

Ms. Nancy Rumrill
U.S. Environmental Protection Agency, Region 9
Drinking Water Protection Services, WTR-3-2
75 Hawthorne Street
San Francisco, California 941055

**Re: Transmittal of supplementary information in support of application for Underground Injection Control (UIC) Permit, Florence Copper Project, Florence Arizona**

Dear Ms. Rumrill:

Pursuant to our telephone conversation, Florence Copper Inc. (Florence Copper) herewith transmits supplemental technical information in support of our application for an Underground Injection Control (UIC) Permit submitted to the United States Environmental Protection Agency (USEPA) on October 4, 2019 (Application). The information transmitted herewith reflects our understanding of questions the USEPA has regarding previously submitted Application materials.

Each of the sections below begins with our stated understanding of the additional information required by the USEPA, followed by our response which includes references to the attached materials.

**Request 1:**

*The USEPA has requested additional information describing the thickness of the Upper Basin Fill Unit, Middle Fine Grain Unit, and the Lower Basin Fill Unit.*

This request is also stated in a letter from David Albright, dated February 13, 2020, which requested additional information pertaining to UIC Permit Application R9UIC-AZ3-FY19-1 (RFI Letter). In addition to responding to Request 1, above, the response below addresses item 20 listed in the RFI Letter.

**Response 1:**

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared four isopach maps that reflect the thickness of each of these geologic units and the thickness of the Bedrock Oxide ore zone. The isopach maps are included herewith as Figures 1 through 4.

These maps were prepared using geologic information obtained from coreholes drilled by previous site owners and Florence Copper within the proposed In-Situ Copper Recovery (ISCR) wellfield and surrounding area. As stated in Attachment A of the Application, a total of 308 coreholes were drilled within the planned ISCR wellfield by Conoco, Magma, and BHP. Geologic records from these coreholes were used to develop a geologic model reflecting the location and orientation of the various geologic

contacts within the planned ISCR wellfield and the proposed Area of Review (AOR). The isopachs shown on Figures 1 through 4 reflect the geologic contacts rendered in the geologic model.

The isopach maps shown on Figures 1 through 4 supplement the detailed subsurface lithologic and geological structure information submitted in Attachment B of the Application. The materials submitted in Attachment B of the Application include four detailed cross sections through the ISCR wellfield area, two generalized cross sections showing regional geologic structure, and a geologic map showing geologic detail for the Florence Copper site and surrounding area.

**Request 2:**

*The USEPA has requested information describing the hydraulic conductivity of the Sulfide zone, which underlies the Bedrock Oxide unit.*

This request is also stated in the RFI Letter. In addition to responding to Request 4, above, the response below addresses item 23 listed in the RFI Letter.

**Response 2:**

The Sulfide zone is a bedrock unit that underlies the Bedrock Oxide unit and is distinguished from that unit by differences in mineralogical composition. In addition to having a different mineralogical composition, it has a much lower hydraulic conductivity than the overlying Bedrock Oxide. The groundwater model described in Attachment A of the Application characterizes the Sulfide zone as hydrologic bedrock which is effectively impervious to groundwater flow. The Sulfide zone effectively serves as the bottom no-flow boundary of the model. This assumption was incorporated into the groundwater flow model constructed in support of the 2012 and 2014 UIC applications that resulted in issuance of UIC Permit R9UIC-AZ3-FY11-1 and is consistent with groundwater modeling assumptions used by previous site owners.

The assumption that the Sulfide zone does not support groundwater flow is based on observations made during aquifer tests conducted at the Florence Copper site on behalf of previous site owners and analyzed by Golder (1995). The Golder (1995) report describes aquifer tests conducted at 26 pumping wells, with each test recording observations from multiple observation wells, resulting in 85 independent hydraulic analyses at the Florence Copper site. These tests included observations at two wells constructed in the Sulfide zone (wells M5-S and M13-S) and one well constructed in an upward displaced block of sulfide material (well O28.2-S). Table E-1 of the Golder (1995) report shows that wells M5-S and M13-S did not have a hydraulic response to pumping conducted at wells located nearby and screened in the Bedrock Oxide unit. These observations indicate that pumping in the Bedrock Oxide unit did not induce hydraulic influence on wells completed in the Sulfide zone. Given the lack of hydraulic response in the sulfide wells, no pumping tests were conducted in the sulfide wells. The Golder (1995) report was included as Exhibit B-2 in Attachment B of the Application.

One of the sulfide wells constructed at the Florence Copper site (well O28.2-S) is not considered representative of Sulfide zone hydraulic conductivity because it was constructed in a block of formation material that has been displaced upward to a relatively shallow position and is horizontally adjacent to highly fractured Bedrock Oxide material. Pumping tests that included well O28.2-S did show a response to pumping in the Bedrock Oxide; however, the screened interval in both the pumping and observation well were completed at the same depth, although in different geologic units.

Brown and Caldwell (1996) conducted slug tests in the sulfide unit wells which produced hydraulic conductivity values between one and three orders of magnitude lower than those measured in the Bedrock Oxide unit. Sulfide bedrock hydraulic conductivity values, developed by Brown and Caldwell (1996), ranged from 0.0055 to 0.05 feet per day.

The assumption that the Sulfide zone is effectively hydrologic bedrock is supported by previously reported aquifer test results and is consistent with previous groundwater models used to support applications for UIC permits at the Florence Copper site.

**Request 3:**

*The USEPA observed that there is no legend on Figures A4 through A13 of Attachment A of the Application.*

This request is also stated in the RFI Letter. In addition to responding to Request 3, above, the response below addresses item 13 listed in the RFI Letter.

**Response 3:**

Figures A4 through A13 have been revised to include a legend in each panel of each Figure. The Revised figures are enclosed with this document.

**Request 4:**

*The USEPA noted that the basis for porosity values used in the 2012 groundwater model was not provided in the 2019 UIC Application.*

This request is also stated in the RFI Letter. In addition to responding to Request 4, above, the response below addresses item 7 listed in the RFI Letter.

**Response 4:**

The groundwater model developed in support of the 2012 UIC Application served as the basis for the model update described in the 2019 UIC Application. The 2019 model update (described in Exhibit A-2 of Attachment A of the Application) included a revision of the earlier porosity values based on neutron porosity logs run in boreholes at the Production Test Facility (PTF). These new porosity data represent the best available information describing porosity conditions within the injection and recovery zone. The earlier 2012 groundwater model included porosity values developed by Brown and Caldwell (1996) based on aquifer tests conducted at the Florence Copper site in 1994 and 1995. The Brown and Caldwell (1996) report was cited as the source for porosity values in the model report prepared in support of the 2012 and 2014 UIC applications for the Florence Copper site.

**Request 5:**

*The USEPA noted that the total depth of each well is not listed in all of the tables included in Attachment A of the Application.*

**Response 5:**

Haley & Aldrich reviewed each of the well and corehole tables included in the Application and noted that Tables A-4 and A-5 list casing depths but not total depths for selected wells. Tables A-4 and A-5 list wells within one mile of the Pollutant Management Area occurring outside the Florence Copper property boundary, and wells within the Florence Copper property boundary, respectively. These tables have been updated to reflect the total depth of each well, and the revised Tables A-4 and A-5 are attached to this document.

**Request 6:**

*The USEPA requested information regarding the formation of precipitates during the formation rinsing phase of the planned ISCR project.*

**Response 6:**

During rinsing, residual solution will be pumped from the ISCR wellfield, neutralized, and placed in one of the water impoundments. The neutralization process will raise the pH of the solution, decreasing the solubility of residual mineral material causing it to precipitate out of solution. Solids precipitating out of the rinsing solution will remain in the water impoundment and the water will be allowed to evaporate.

During rinsing, it is anticipated that soluble mineral species will stay in solution until the solution is neutralized and that insoluble mineral species will remain in the formation. As the pH of the rinsing solution gradually increases, the capacity of the solution to dissolve additional mineral material will attenuate and the relative solubility of formation minerals will decrease.

The neutralization process is included in the water treatment component shown on the rinsing flow sheet (Figure 6-2) included in Exhibit D-1 of Attachment D of the Application. The solids accumulation rate and placement location during rinsing are also shown on Figure 6-2. Each of the flow streams that will be active during rinsing are described in the Technical Memorandum included in Exhibit D-1 of Attachment D of the Application. The forecast solution composition before or after rinsing are described in the Technical Memorandum included in Exhibit D-3 of Attachment D of the Application.

**Request 7:**

*The USEPA requested additional information regarding the application of the 2.0 mg/L sulfate value for delineation of the edge of the area affected by post-closure migration of residual sulfate.*

**Response 7:**

The 2.0 milligrams per liter (mg/L) sulfate values used for the delineation of the edge of the area affected by post-closure migration of residual sulfate is the same value applied in the 2012 and 2014 UIC permit applications submitted by Florence Copper. This value was defined based on the Practical Quantitation Limit (PQL) for sulfate concentration as determined by USEPA Test Method 300. The PQL for sulfate

analyses performed by the laboratory used for site water quality analyses (Test America, Phoenix) is 2.0 mg/L. This means that the laboratory cannot reliably distinguish sulfate analytical results to a resolution finer that 2.0 mg/L, or reliably reproduce analytical results with a precision of less than 2.0 mg/L using USEPA Test Method 300. Therefore, the greatest areal extent of sulfate migration as a result of operation of discharging facilities was defined at a sulfate concentration of 2.0 mg/L above background conditions.

Please contact me at 520-316-3710 if you require any additional information.

Sincerely,
Florence Copper Inc.

Richard Tremblay
Vice President Operations

cc: Maribeth Greenslade, Arizona Department of Environmental Quality

Enclosures

**References:**

Brown and Caldwell, 1996. Magma Florence In-Situ Project Aquifer Protection Permit Application, Volume IV of V, Modeling Report. January.

Golder Associates, 1995. Data Report for Initial Interpretation of the Hydraulic Tests at the Florence Mine Site for Magma Copper Company Aquifer Protection Permit Florence In-Situ Leaching Project.